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ABSTRACT

Westinghouse Learning Corporation's (WLC) cost and effectiveness experiences for the preparation of instructional units in the United States Naval Academy leadership course (see the final reports which summarize the course development project, EM 010 418, EM 010 419, and EM 010 484) are reported in this document. The cost collection system is explained, cost experiences and instructional effectiveness for various media and presentation forms are presented, and a discussion of cost versus effectiveness is provided based on the data gained in the project. EM 010 420 through EM 010 447 and EM 010 451 through EM 010 512 are related documents. (SH)

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COST EFFECTIVENESS

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ABSTRACT

This report summarizes WLC's methodology for determining the relative cost effectiveness of instructional units in the U. S. Naval Academy multimedia Leadership Course. Representative costs in relation to instructional effectiveness are reported and comparisons are made.

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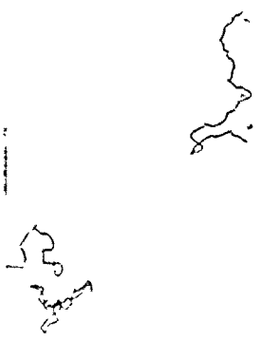
I. INTRODUCTION

This document reports Westinghouse Learning Corporation's (WLC) cost and effectiveness experiences for the preparation of instructional units in the U. S. Naval Academy multimedia Leadership Course. The cost collection system is explained, cost experiences and instructional effectiveness for various media and presentation forms are reported, and a discussion of cost versus effectiveness is presented based on the data gained in this project.

Over the course of the project, we have taken advantage of several different perspectives in planning for cost accounting and its documentation, as reported in this document. The skills of project management and accounting groups in the New York corporate offices have been employed to ensure that corporate cost procedures were adhered to, that ease of audit was permitted and that newly available techniques were incorporated into the system as they applied.

Major sources of information and guidance for the planning and preparation of this document have been several representative "state-of-the-art" reports that examine this area of study. These sources, identified in the bibliography, reflect a broad range of efforts in civilian as well as military instructional development projects.

We have gained much insight into cost effective study problems from the full text of a paper, "On the Economic Analysis of Educational Technology" prepared in early 1969 for the Indiana State Department of Instruction and that state's Tax and Finance Policy Commission, by Herbert Kiesling, an economist at Indiana University.



II. OVERVIEW

The necessity for cost effectiveness reporting stems from the need to weigh the relative merits of one medium or presentation form against another, particularly when one medium is more or less effective than another. When equivalent student performance results can be obtained from a variety of media or presentation forms, the cost of developing and revising, after testing, becomes a relevant factor of some importance.

The basic methodology employed in the project reported here was (1) the systematic collection of costs associated with segment development for each of the media/presentation forms; and, (2) the comparison of accumulated costs to the relative effectiveness of the various segments, as indicated by the performance indices.

This report concerns the costs of developing a segment (approximately 50 minutes of student time) of instructional materials in various media (video tape, audio tape) and presentation forms (linear, branching and syndactic programed texts and detailed self-study guides) [1] to the point where any given number of copies

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1 Presentation forms as defined for this paper refers to subsets of the printed media.

may be reproduced for the course at hand. Development costs here begin when reliable terminal and enabling objectives and/or a suitable content outline is already available. Development costs end when a completed "camera-ready" copy is ready for delivery to the printer, or when a "master" video/audio tape is ready for quantity duplication. The appropriate Progress Check (criterion test) and, where necessary, accompanying panelbooks are considered an integral and necessary part of all instructional segments; therefore, these costs are rightly included as development costs.

The importance of costing activities requires clear statement and understanding of the objective desired of the activities. The goal of this paper is not to provide a comprehensive and precise profile of all of the costs incurred with each of the media systems. It is neither feasible within existing project constraints, nor is it felt to be necessary to prepare a detailed cost specification to reflect total, current or anticipated expenses for finely-drawn activity categories. Thus, another agency is cautioned lest this data be used as a definitive predictive device for all steps of instructional development or media purchase, installation and operation.

What is desired, rather, is what might be considered a useful "order-of-magnitude" cost comparison

for the development of instruction in the selected media. In other words, it is of greater importance for this paper to have a careful compilation of cost differences and similarities (in terms of supportable extrapolations and approximations) than to have complete and documented cost totals for a wide variety of cost categories.

In this regard, critical costs must be included in the calculations and extrapolations, but it is not necessary to include all possible costs. Critical cost items include those factors which have a major impact on the total "development" costs, which are of interest for purposes of subsequent comparison in this report. At the same time a number of other items are ignored, such as initial specification of objectives, administration, staff development, etc. These are without question part of the comprehensive total system costs, but are not critical in the terms of this report, since these factors vary widely in every development project.

The costs reported in connection with the development of various media/presentation forms represent another standard, added to existing cost reports, against which costs incurred by other agencies in developing similar instruction can be compared.

III. COST COLLECTION SYSTEM

The present cost accounting system has been structured to isolate labor and non-labor costs pertinent to both the development of the multimedia Naval Leadership Course and to the research which has been conducted during the development and validation of the course. Many of the costs accrued during the total project are not relevant to the development of individual instructional materials alone, but may be attributed to such systems efforts as: research, coordination, travel, and the writing of reports not directly connected with course development. As such, the cost accounting system is devised to isolate those costs which are specific to the multimedia instructional system and those which are tangential or irrelevant in the actual development.

The specific objective of this cost accounting, in relation to a cost effectiveness study, is to provide breakdown costs for preparation of instructional segments in a variety of media or presentation forms.

It should be pointed out that although the cost accounting system is based on the Course Development Model (TP-6.1), there are necessary discrepancies between some of the tasks identified in each. In general, the course development model isolates groups

of tasks which may be more inclusive than those itemized in the cost accounting system. Reasons are that some tasks must be performed in groups to initiate subsequent tasks within the same general area. The components of the tasks may be of such magnitude that they warrant charges against them, and yet they derive their importance for the course development model only when viewed in combination with other related tasks.

Although specific tasks identified in the course development model and cost accounting system may not be identical, all of the cost accounting function areas are included and recognized in the development model. The additional function areas specified in the latter paper, such as project management and customer interaction, do not carry costing numbers, yet they are necessary as links for the other functions. They are not, however, considered here since they are beyond the scope of this report. Details of the collection system for these costs are contained in an earlier cost effectiveness report (TP-6.5) dated March 7, 1969.

In the area of developing the instructional materials, the costs are first classified according to a General Order Number representing gross activity groups which correspond roughly to contractual phases

and production cycles.

General Order Numbers: (Note: Early production occurred at both Behavior Systems Division, Albuquerque and the Annapolis Division)

BSD	ANNAPOLIS	
15031	15100	Cycle 1: All charges relating to materials development prior to the first submission for review by USNA.
15032	15101	Cycle 2: All revision charges incurred following the first submission of materials to the USNA through final acceptance form of the primary module in each segment by USNA.
15033	15102	Cycle 3: Production, manufacture and revision of presentation materials, prior to the spring validation period. Revision activity charges restricted to in-house requirements.
15034	15103	Cycle 4: Revision activity relating to changes required in presentation materials by USNA prior to presentation to Midshipmen.
15035	15104	Cycle 5: All costs relating specifically to the validation presentation.

----	15105	Cycle 6: All costs relating to revision activity resulting from the spring validation presentation.
	15106	Production: All costs relating to the preparation of cumulative posttests (not segment progress checks).
	15107	Not Used
	15108	Not Used
	15109	Not Used
	15110	Production: All charges relating to materials development for submission to USNA.
	15111	Evaluation and Research: All charges incurred in connection with evaluation of data, S-testing, reports, and computer services.
	15112	Special Materials: Production, manufacture and revision of depth core materials, and charges related to special media equipment such as CBI-70 and COPAR.
	15113	1971 Revision: Revision activity relating to changes required due to revision of fall run for spring run.

15114 Structural Communications: All costs relating specifically to Structural Communications. Budget Center is B 46.

15115 Not Used.

Within a given General Order function, charges are then further separated by specific part and segment of the instructional system.

PART	SEGMENT	CODE POSITIONS 6 & 7	PART	SEGMENT	CODE POSITIONS 6 & 7
I	1	40	IV	1	56
	2	41		2	57
II	1	42		3	58
	2	43		4	59
	3	44		5	60
	4	45		6	61
	5	46		7	62
	6	47		8	63
	7	48	V	1	64
	8	49		2	65
	9	50		3	66
III	1	51		4	67
	2	52		5	68
	3	53		6	69
	4	54		7	70
	5	55		8	71
				9	72
				10	73

PART	SEGMENT	CODE POSITIONS 6 & 7	PART	SEGMENT	CODE POSITIONS 6 & 7
VI	1	01	IX	1	16
	2	02		2	17
	3	03	X	1	18
	4	04		2	19
VII	1	05	XI	1	20
	2	06		2	21
	3	07		3	22
	4	08	XII	1	23
	5	09		2	24
VIII	1	10		3	25
	2	11		4	26
	3	12			
	4	13			
	5	14			
	6	15			

Work not assignable to a specific segment or task	00
All research activities	99
All work and costs related to administrative activities	98
All work and costs related to administrative tests	97
Instructors Guide activities and related costs	96
Student Guide activities and related costs	95

Next, costs are charged to a specific activity for, or in support of, the production of materials.

DESIGNATOR	DESCRIPTION
A	Administration
B	Analysis-Writing-Behavioral Edit-Test Items
C	Editorial
D	Typing
E	Production and Control Administration
F	Subject Matter Expert (SME)
G	Media Technician (audio visual work)
H	Research (media, data processing, cumulative posttests)
J	Illustration (layout and art)
K	Secretarial
M	S-Testing (validation of materials)
N	Programmer - Data Processing
O	Systems Analyst - Data Processing
P	Statistician
R	On Site Instructor
S	On Site Remedial Tutor
T	Printing

Each activity for every segment is finally assigned to a designated cost class.

DESIGNATOR	DESCRIPTION
A	Labor
B	Materials
C	Communications
D	Travel

An example will serve to illustrate the manner in which all personnel have reported their labor and/or expenses for the development of the instructional materials.

Assuming a member of the production group reported eight hours of time with the 13 digit sequence: 15100071BAB47. Thus -

15100 designates the function area of materials production prior to first submission for USNA review.

07 designates the task of preparing instructional materials for Part Seven, Segment 3, specifically.

1 is a standard WLC separator (digits 2, 3, 4, etc. here reflect modules of the segment, which constitute research variations of identical instructional content).

B designates the activity: analysis, writing or behavioral edit of instructional materials.

A designates the cost class: Labor

B47 designates the WLC budget center for Annapolis Division.

All costs connected with the preparation of a given instructional segment have been charged against a similar 13-digit code, the difference being in the activity and cost class designators. For example, if the charge is for travel by the media technician, the

activity and cost class designators would be GD, where G represents audiovisual work and D indicates travel. If the charge were for a necessary reference book or other material the designators AB would reflect administrative activity (A) and material or service (B).

All labor and non-labor detail reports are submitted weekly to the WLC computing system. In addition to labor itemization, printouts are made of specific non-labor charges with respect to the item purchased or rented and the draft number of the order. In this way, it is possible to verify the applicability of the non-labor charge to both the function and task area.

It should be noted that as new tasks are identified, they can be added under the appropriate function area - up to 99 tasks. Designators will be assigned as new labor and non-labor costing needs arise.

Another relevant aspect of the cost accounting system is the isolation of specific module costs for material preparation in media and presentation forms dictated by the research design. These costs are the specific costs incurred in finalizing materials for a module after the content has been specified and analyzed. Accounting for module costs has been accomplished by use of the same 13-digit alpha-numeric code.

For example, the sequence 15102444CAB47 represents the following:

15102	Cycle 3: Production of subsidiary module presentation materials.
44	designates preparation of materials for Part Two, Segment 3.
4	designates work for module 4 of the given segment (See details below).
C	designates the activity: editing
A	designates the cost class: labor
B47	reflects the Annapolis budget cente.

Segment 3 of Part Two was prepared in four modules representing two media forms, with one variation of each. Module 1 was a video tape presentation with high response demand frequency and covert resonding; module 2: video tape with low response demand frequency for overt responses; module 3: audio tape and panelbook with low resonse demand frequency for covert responses; and, module 4: audio tape and panelbook with high response demand frequency for overt responses. The variables for specific modules were dictated by the research design.

To ensure accuracy in labor and non-labor charges, all WLC personnel assigned to the USNA project were thoroughly briefed and supervised in the preparation of time cards with respect to the appropriate function area, task and extension numbers.

IV. DESCRIPTION OF MEDIA AND PRESENTATION FORMS

Instruction for the USNA Leadership Course was presented via audio tapes with panelbooks, video tapes with panelbooks, linear programed texts, syndactic texts, audio tapes with intrinsically programed texts, learning activities summaries, and computer-assisted instruction. A description of the media and presentation forms follows.

VIDEOTAPES (VT/PB)

Videotapes were used to present content in lecture format. The lecturer for all video tape segments was an active Naval officer with teaching background. With the aid of a teleprompter, the lecturer presented all material verbatum from a prepared script.

All video tapes were prepared at a commercial television station. Commercial quality quad video tape recorders were used which provided a degree of quality unavailable in one inch VTR format. Two cameras were used in taping the lecture to allow for integration of a series of visuals (charts, photographs, drawings, etc.). Additionally, key points of content were superimposed on the screen during the program.

At appropriate points in the lecture, the lecturer referred the students to a numbered question in the panelbook. Students read the question and recorded

their answers in the panelbook. Sufficient time was allowed for students to respond so they did not have to turn off the VTR. The number of questions asked ranged from 15 to 22.

AUDIOTAPES (AT/PB)

Audiotapes with panelbooks were used to present content in lecture format. The lecturer was a commercial radio announcer who presented all material verbatum from a prepared script. In all audio/video research segments, the scripts for audio and video presentations were identical.

All audiotapes were developed in a commercial recording facility. In developing the audio presentations, standard recording tapes were used. For student use, tapes were transferred to C-60 and C-90 cassette cartridges.

All charts, photographs, drawings, etc., accompanying the audiotape lecture were presented in a panelbook. (It should be noted that for videotape modules, these charts, etc., were presented on the VTR.)

At appropriate points in the lecture, the lecturer referred the students to a numbered question in the panelbook. Students read the questions and recorded their answers in the panelbook. Sufficient time was allowed for students to respond so they did not have to turn off the cassette recorder. The number

of questions asked ranged from 15 to 22.

AUDIOTAPE AND INTRINSICALLY PROGRAMED TEXT (AT/IP)

As originated by Norman A. Crowder, the intrinsic programing technique consisted of routing a student through a "scrambled" text on the basis of his response. Each response directed him to a different page of the text; thus, the student could not read through directly and sequentially.

Combining the intrinsic programing technique with an audiotape was a WLC innovation. In this teaching mode, the information was presented via the tape. While the student listened to it, he also looked at a summary page in the text which contained a precis of what he was hearing. He then stopped the tape and followed the instructions at the bottom of the summary page, directing him to a page containing a question which tested the information given on the tape and summary. Each response to the question referred the student to another page which informed him of the accuracy of that response. Thus, the student would select the alternative which he thought was correct, turn to the page indicated for that alternative, and find out if he had made a correct selection. If he had selected the correct response, he was instructed to go on to another summary page which he read while listening to the next audio portion. If his response

was partially correct or incorrect, he was either told the nature of his error and instructed to proceed as described above, or he was instructed to return to the summary or question page to study the information again and select another alternative. This process of interaction between tape and text continued throughout the segment.

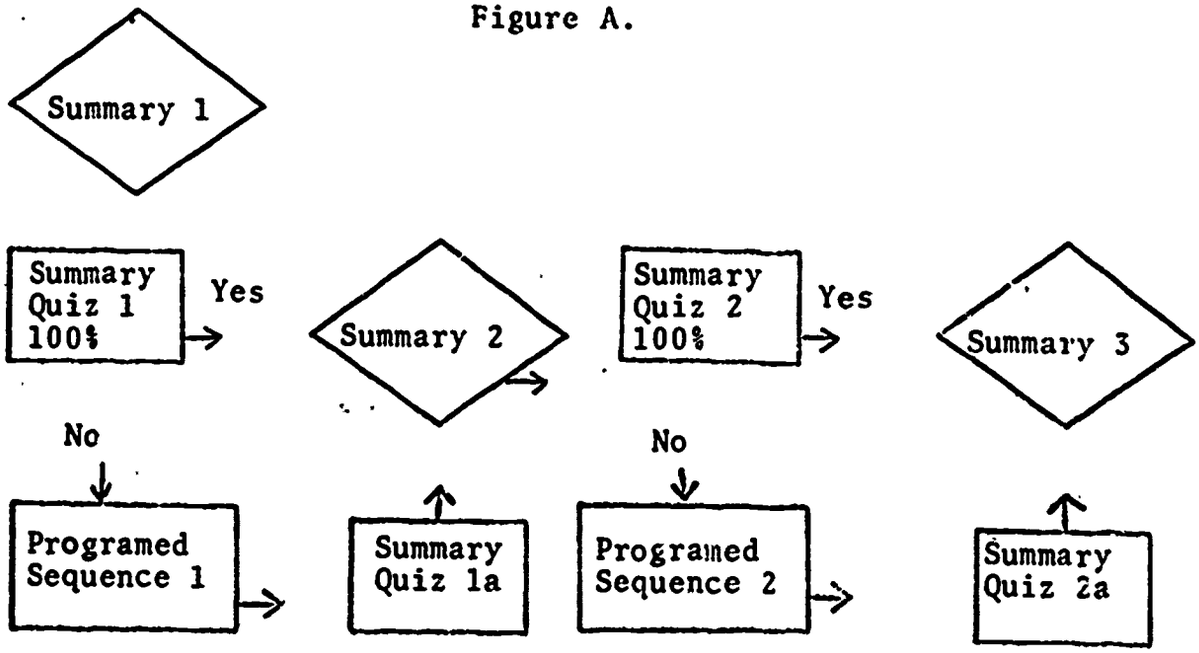
SYNDACTIC TEXT (ST)

A syndactic text is essentially a series of linear programed frames each preceded by a brief but complete summary of the information presented in the frames. Students worked through the syndactic text by reading the first summary statement and taking a summary quiz of 5 to 8 questions. If the student answered all summary quiz questions correctly, he read the second summary, took summary quiz 2, etc.

The student who incorrectly answered one or more questions of a summary quiz was required to study the linear programed sequence associated with that summary. At the end of the programed sequence, the student retook the summary quiz. Regardless of his performance when he retook the summary quiz, he went on to the next summary statement and repeated the procedure.

Figure A. illustrates student progress through the syndactic text.

Figure A.



LINEAR PROGRAMED TEXT (LP)

Linear programed texts used were developed by the RULEG and EGRUL methods of programing (Rule-example; example-rule). These are essentially programing methods of presenting a rule (definition, principle) and having the student identify an example of the rule (from 2, 3, or 4 choices), or presenting an example and having the student identify the rule or principle which is depicted in the example.

Students were instructed to respond to each frame by writing their selection (A, B, C, or D) on the frame answer sheets.

LEARNING ACTIVITY SUMMARY (LAS)

A learning activity summary is similar to a traditional textbook or bibliography approach to learning. It is a technique very often used in college and graduate seminars to put the responsibility for structuring learning and achieving objectives on the student. A learning activity summary was composed of three parts: 1) an overview of the segment, 2) behavioral objectives for the segment, 3) a bibliography of source material that was related to each of the objectives. Students worked through an LAS segment by reading the overview and objectives and studying text materials which were related to each objective. Text materials were either select pages in published text books or supplemental handouts.

The student studied all text material until he felt he had mastered the objectives and could pass the progress check. If he did not achieve 80% of the objectives on the progress check, he remediated by re-studying the prescribed text material.

COMPUTER ASSISTED INSTRUCTION (CAI)

Four instructional segments were developed as CAI material for the 1500 Instructional System. All of the three components of the system (CRT, audio, and image projector) were utilized in the instructional units.

The information frames are presented on the CRT screen and image projector. The questions, which are often situations in which the student had to decide the best course of action, are presented: 1) on the audio, where the situation is described; 2) on the image projector, where pictures of the situation are presented along with the audio; 3) on the CRT screen, where the student is asked to select an answer from 3 to 5 choices. The student's selection, accompanied by feedback, is displayed on either the CRT screen or the audio tape, and occasionally on the image projector. This feedback consists of remediation explaining why the selected answer was correct or incorrect.

The following Outline of Course Structure and Media amply portrays the mix of media and presentation forms as originally developed for this course of instruction. (Note: It should be pointed out that the outline shown does not indicate media and presentation forms for specific instructional units as they exist at the end of the project. The most obvious discrepancy is the complete lack of videotaped instructional units, which have been deleted, for various reasons, prior to the end of the project.)

TABLE 1

OUTLINE OF COURSE STRUCTURE AND MEDIA

Part and Seg. No.	Content Heading	Medium [a]
	PART ONE: OVERVIEW OF LEADERSHIP	
1.1	Concepts of Leadership	ST
1.2	Standards of Leadership in the Naval Service	F-GD
	PART TWO: INDIVIDUAL BEHAVIOR	
2.1	Introduction to Psychology	ST
2.2	Behavior and its Observation	AT- or VT-PB
2.3	Learning	AT- or VT-PB
2.4	Factors Affecting Learning	AT- or VT-PB
2.5	Attention and Perception	AT- or VT-PB
2.6	Motivation	ST
2.7	Conflict	ST
2.8	Neurotic and Psychotic Reactions	ST
2.9	Personality	LAS
	PART THREE: GROUP DYNAMICS	
3.1	Characteristics of Groups	AT- or VT-PB
3.2	The Relationship of the Leader to the Group	AT- or VT-PB
3.3	Group Interactions	AT- or VT-PB
3.4	Conformity as a Factor of Group Behavior	AT- or VT-PB
3.5	Relation of the Individual to the Group	ST
	PART FOUR: ACHIEVING EFFECTIVE COMMUNICATION	
4.1	Importance of Interpersonal Communication	LP
4.2	Types of Communication	LP
4.3	The Communication Process (Receiver and Barriers)	LP
4.4	The Communication Process (Sender and Feedback)	AT-IP
4.5	Formal Communication and Its Dimensions	AT-IP
4.6	Informal Communication	AT-IP
4.7	Communication Under Battle Situations	AT-IP

TABLE 1 Continued

Part and Seg. No.	Content Heading	Medium [a]
	PART FIVE: MILITARY MANAGEMENT	
5.1	Introduction to Management and the Management Process	ST
5.2	Decision Making and Creativity	ST
5.3	Objectives	ST
5.4	Planning	LP
5.5	Organizing: Principles and Process	LP
5.6	Organizing: Structure	LP
5.7	Organizing: Charting	AT- or VT-PB
5.8	Directing	AT- or VT-PB
5.9	Controlling	AT- or VT-PB
5.10	Coordinating	AT- or VT-PB
	PART SIX: AUTHORITY AND RESPONSIBILITY	
6.1	Concept of Authority	ST
6.2	Why People Accept/Resist Authority	ST
6.3	Delegation of Authority; Line-Staff Relationship	ST
6.4	Responsibility	ST
	PART SEVEN: LEADERSHIP BEHAVIOR AND STYLE	
7.1	Leadership Behavior	AT- or VT-PB
7.2	Leadership Style	AT- or VT-PB
7.3	Determiners of Leadership Style - The Leader	AT- or VT-PB
7.4	Determiners of Leadership Style - The Group and the Situation	AT- or VT-PB
7.5	Participative Leadership	VT-PB
	PART EIGHT: SENIOR-SUBORDINATE RELATIONSHIPS	
8.1	Organizational Structure & Social Distance in Senior-Subordinate Relationships	LP
8.2	Officer-Enlisted Relationships	LP
8.3	Assumption of Command and Formal & Informal Leader Relationships	LP
8.4	Introduction to Counseling	LAS
8.5	The Counseling Process	LAS
8.6	Relations with Seniors and Contemporaries	LAS

TABLE 1 Continued

Part and Seg. No.	Content Heading	Medium [a]
	PART NINE: MORALE - ESPRIT DE CORPS	
9.1	Morale	VT-PB
9.2	Group Solidarity and Esprit	VT-PB
	PART TEN: DISCIPLINE	
10.1	Introduction to Discipline	AT-IP
10.2	Development and Maintenance of Discipline	AT-IP
	PART ELEVEN: PERSONNEL EVALUATION	
11.1	The Role of Evaluation	ST
11.2	Enlisted Performance Evaluation	ST
11.3	Officer Evaluation	ST
	PART TWELVE: APPLIED LEADERSHIP	
12.1	Measurement of Effective Leadership	CAI
12.2	Generally Recognized Characteristics of an Effective Leader	CAI
12.3	Techniques of Assuming Command	CAI
12.4	"That's an Order!"	CAI

[a] ST=Syndactic (multi-level) Text;
F-GD=Film, Group Discussion;
AT=Audiotape;
VT=Videotape;
PB=Panelbook;
LAS=Learning Activities Summary;
LP=Linear Text;
IP=Intrinsic Program;
CAI=Computer Assisted Instruction.

V. COST EFFECTIVENESS PRESENTATION

A. Derivation of Costs Presented.

There are several general costing guidelines that are applicable to all media costs in this report. As stated earlier, this report deals with the costs of developing instructional materials after suitable objectives and the scope of the content have been settled, and up to the point where a complete "master" copy is ready for quantity reproduction.

It is felt that inclusion of overhead and various administrative costs would render a figure of little value to those concerned with developing validated instructional materials, unless they, too, have identical overhead ratios and administrative staff and facilities.

For much the same reason, and based on actual experience, the costs of preparing terminal and enabling objectives and/or a content outline vary to such a degree as to be of little value for future use. The delicate negotiation and coordination necessary between those persons responsible for course curriculum decisions and those persons responsible for materials development consumes widely varying amounts of time depending, not only on the nature of the instructional content, but also on the personalities of the personnel involved.

The experiences in this project at preparing acceptable objectives and content are detailed in the final report for the entire project.

The cost variations experienced in the actual production of different quantities of the instructional materials themselves prompts the elimination of this factor from the compilations shown. During the rather long life of the project it was necessary, for various reasons, to change the source of reproduction for certain materials. Needless to say, the costs involved did not remain stable. Equipment purchases, installation and maintenance, too, varied considerably and have not been given consideration here. Decision-makers for future activities can quickly and easily determine such costs for their particular project from normally available sources.

Time and space constraints prevent reporting developmental costs for each media or presentation form in the specific, finely-drawn detail that the cost collection system permits. The extreme breadth of detail available for reporting can be envisioned by considering that instructional materials have been developed in video tape with panelbook, audio tape with panelbook, audio tape with intrinsically programed book, syndactic text, linear programed text, and computer-assisted instruction (CAI). The research goals and design then

forced the preparation of parallel materials to study such variables as: high, medium and low response demand frequency, high and medium management frequency, overt written and overt oral responding and covert responding.

Cost data is available for every variation, but bears little relevance to cost expectations for future decisions. Once the "primary" instructional materials, in whatever form, have been prepared, the preparation of parallel instruction to study research variables becomes quite simple and inexpensive. This was the strategy of this project: to prepare "primary" instructional units first, then the parallel materials for research. Data in this report is limited to the development of the primary instructional units.

Not all instructional units are of the same length, but vary from approximately thirty-four minutes to just over one hour, depending upon presentation form and specific content. Therefore, an average cost for each developmental function has been derived for each media and presentation form as detailed in Section V.B., Tables 2 to 8 . The costs attributed to the computer programmer for CAI is the average of such costs for each of the four CAI units. In the same way, the costs attributed to writing or editing or typing a linear text is the average of costs for that specific function in the preparation of all linear programed texts.

B. Costs per Media/Presentation Form.

As stated earlier, costs shown in the following tables (2 through 8) are limited to averages for the development of a primary instructional unit for each media or presentation form, excluding specification of objectives and content, and further excluding quantity reproduction for actual student use. Costs are grouped according to relevant activities in the initial development process: Writer, AV Technician, Editor, Subject Matter Expert, related developmental production functions, etc.

Costs peculiar to only one medium, such as: video studio and equipment rental and technical personnel or computer programmers, are clearly identified in the table for the specific medium.

For convenience, the following definitions have been used as necessary in this report:

VT/PB	Videotape with panelbook
AT/PB	Audiotape with panelbook
AT/IP	Audiotape with intrinsically programed text
ST	Syndactic Text
LP	Linear Programed Text
LAS	Learning Activities Summary
CAI	Computer Assisted Instruction.

TABLE 2

VIDEOTAPE WITH PANELBOOK (VT/PB)

WRITER - (Script, panelbook questions, specifications for illustrations)			500.
AV TECHNICIAN - (Coordinate art/writing, supervise video taping)			105.
EDITOR -			25.
SUBJECT MATTER EXPERT -			25.
PRODUCTION -			
1. Printed Material			
a. Typist	24.		
b. Proofreader	8.		
c. Artist/Illustrator	100.		
		132.	
2. Video Materials			
a. Studio (Rent, equipment, personnel, Teleprompter script, etc.)	500.		
b. Preparation of slides of illustrations	35.		
c. Lecturer/Narrator	25.		
		560.	
3. Final Subject Matter Review		15.	
			707.
PREPARATION OF PROGRESS CHECK *			600.
	TOTAL		1,962.

TABLE 3

AUDIOTAPE WITH PANELBOOK (AT/PB)

WRITER - (Script, panelbook questions, specifications for illustrations)			500.
AV TECHNICIAN - (Coordinate art/writing, supervise audio taping)			105.
EDITOR -			25.
SUBJECT MATTER EXPERT -			25.
PRODUCTION -			
1. Printed Materials			
a. Typist	24.		
b. Proofreader	8.		
c. Artist/Illustrator	100.		
		132.	
2. Audio Materials			
a. Studio (Rent, equipment, personnel)	35.		
b. Narrator	50.		
c. Tape Editing	40.		
		125.	
3. Final Subject Matter Review		15.	
			272.
PREPARATION OF PROGRESS CHECK *			600.
	TOTAL		1,527.

TABLE 4

AUDIOTAPE WITH INTRINSIC PROGRAM (AT/IP)

WRITER - (Audio script and complete intrinsic program)			750.
AV TECHNICIAN - (Coordinate art/writing, supervise audio taping)			105.
EDITOR -			75.
SUBJECT MATTER EXPERT -			40.
PRODUCTION -			
1. Printed Materials			
a. Typist	60.		
b. Proofreader	40.		
		100.	
2. Audio Materials			
a. Studio (Rent, equipment, personnel)	35.		
b. Narrator	50.		
c. Tape Editing	40.		
		125.	
3. Final Subject Matter Review		20.	
			245.
PREPARATION OF PROGRESS CHECK *			600.
	TOTAL		1,815.

TABLE 5

SYNDACTIC TEXT (ST)

WRITER - (Summaries, internal quizzes, programed sequences)		650.
EDITOR -		40.
SUBJECT MATTER EXPERT -		40.
PRODUCTION -		
1. Typist	60.	
2. Proofreader	35.	
		95.
PREPARATION OF PROGRESS CHECK *		600.
	TOTAL	1,425.

TABLE 6

LINEAR PROGRAM (LP)

WRITER - (Complete linear program)		500.
EDITOR -		40.
SUBJECT MATTER EXPERT -		25.
PRODUCTION -		
1. Typist	24.	
2. Proofreader	18.	
		42.
PREPARATION OF PROGRESS CHECK *		600.
	TOTAL	1,207.

TABLE 7

LEARNING ACTIVITIES SUMMARY (LAS)

WRITER - (Research required references, prepare guided discussion summary)		100.
EDITOR -		25.
SUBJECT MATTER EXPERT		25.
COPYRIGHT ADMINISTRATION -		
1. Correspondence	9.	
2. Copyright Fees	5.	
		14.
PRODUCTION AND ASSEMBLY -		
1. Purchase Required References (one each)	40.	
2. Typist	3.	
3. Local Reproduction (reference exerpts)	3.	
		46.
FINAL SUBJECT MATTER REVIEW -		12.
PREPARATION OF PROGRESS CHECK *		600.
	TOTAL	822.

* A note is in order regarding the uniform cost for Progress Checks (criterion tests) for all instructional units. All tests were prepared directly from the instructional objectives and separately from the instructional materials (even different writers) to ensure maximum subjectivity and to forestall the possibility of "teaching the test". Further, all tests are of comparable size and format. Costing a single test, then, is straightforward and the figure shown ($600. each) is the average for all tests, regardless of instructional presentation.

TABLE 8

COMPUTER ASSISTED INSTRUCTION (CAI)

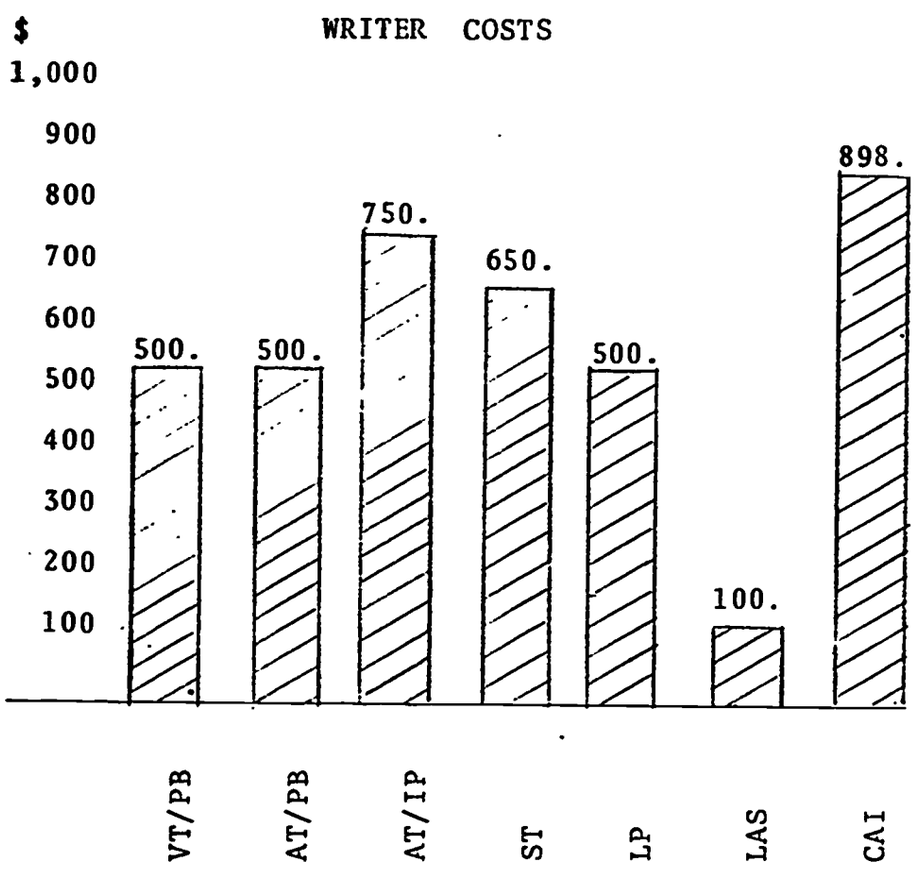
WRITER - (Instructional program, audio script, specifications for illustrations)			898.
AV TECHNICIAN - (Coordinate art/writing, supervise audio taping)			200.
EDITOR -			105.
SUBJECT MATTER EXPERT -			38.
PRODUCTION -			
1. Video Materials			
a. Artist/Illustrator	250.		
b. Film Pack Preparation	308.		
		558.	
2. Audio Materials			
a. Narrator	50.		
b. Audio Pack Preparation	150.		
		200.	
3. Computer Programming		1,163.	
4. Final Subject Matter Review		20.	
			1,941.
PREPARATION OF PROGRESS CHECK *			600.
		TOTAL	3,782.

Two major factors in the development of instructional materials are the writing and production functions. The following paragraphs present and discuss comparisons of these functions for the various instructional forms.

Examination of the writing costs for the various media and presentation forms provides no startling or unexpected results to those familiar with or experienced at preparing such instructional materials.

Figure B. compares the costs of writing the instructional materials for a single primary unit in various forms.

FIGURE B.



The equality of cost for preparing the linear program (LP) and the scripts and panelbooks for video and audio tape presentations stems from the near identity of the tasks involved. Each of the three forms requires the writer to prepare textual materials for the terminal/enabling objectives, interspersed with questions (criterion frames) testing the bit of instruction just given. While the linear program must arrange for a response to every frame, the video and audio scripts require specifications for amplifying or clarifying illustrations and art work. Apparently, one requirement nicely balances the other in demands on the writer's time.

The preparation of the audio tape script with the intrinsic program requires the additional care and time to write the "scrambled" response choices, to write the remediation commonly presented with the various incorrect responses, and the detailed, exact cross-referencing from audio to intrinsic program and vice versa.

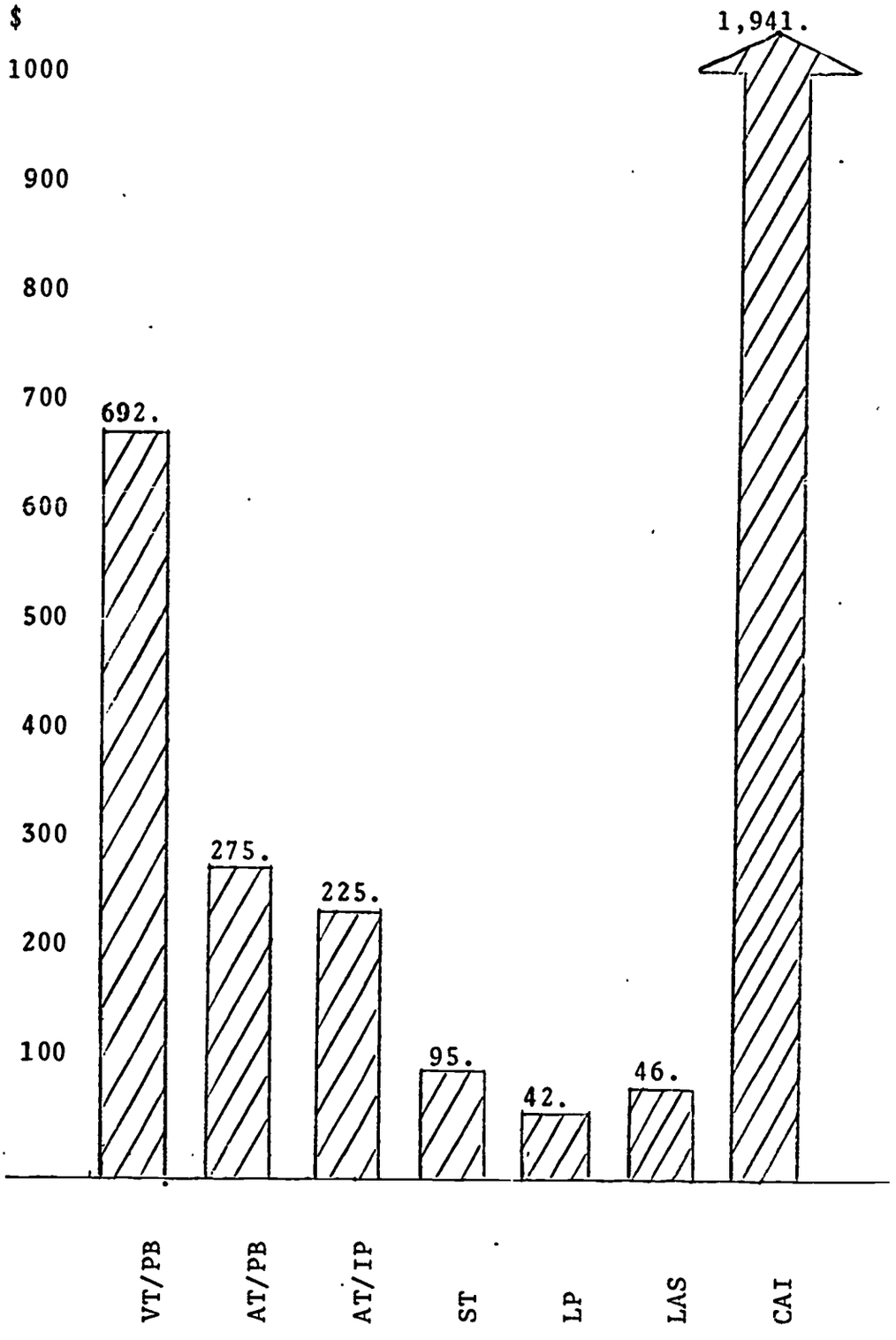
The low cost of writing the Learning Activities Summary reflects the simplicity and brevity of writing tasks required. The objectives for the unit are stated, questions are prepared to guide the student in his search for detail and the requisite textual references are provided. Simple, straightforward and inexpensive.

Writing the instructional program (as opposed to the computer program) for computer-assisted instruction makes the greatest demands on the writer. True, in a sense, it is an intrinsically programed unit, but for the configuration used in this project the writer must plan and prepare an audio script for the audio mode, a complex intrinsic program for the cathode ray tube display and specifications for illustrations via the image projector, plus specifying some arrangement to accept either constructed or selected responses. All must, of course, function in perfect unison and sequence to provide for effective learning. Quite a challenge to and time consuming for even the most highly skilled writer.

The display of developmental production costs in Figure C also holds no mysteries for the initiated. In the purely textual forms, as bulk of the text and the resulting page count increases, so do the production costs. Add the audio medium, and the costs of preparing the master tape (studio, narrator) must be considered.

FIGURE C.

DEVELOPMENTAL PRODUCTION COSTS

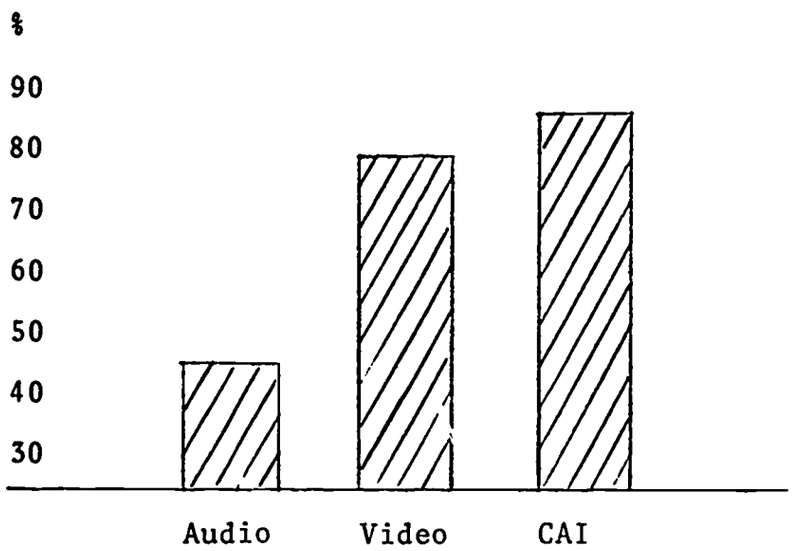


A sobering fact emerges as one examines the individual costs grouped as developmental production costs for various media forms. The cost to obtain a similar product (one master copy) increases dramatically as one moves from audio to video to CAI forms. Eliminating the typist, proofreader, artist/ illustrator and final review functions leaves those costs peculiar to the given instructional media form.

FIGURE D.

MEDIA PRODUCTION AS % OF

TOTAL DEVELOPMENTAL PRODUCTION COST



Thus, production costs peculiar to audio tape segments (studio rent, equipment, personnel plus narrator plus the editing) represent 45.5% of the total developmental production cost. Production costs

peculiar to video tape segments (studio rent, equipment, personnel plus illustrative slides plus lecturer) represent 80.9% of the total video developmental production cost, and a far higher actual dollar cost than audio tapes. Production costs unique to CAI represent an even higher percentage of its total developmental production cost. Preparation of the image projector film pack plus the audio tape plus the computer programer reaches 86% of the total production cost. It should be noted that, by itself, the computer programer cost for a single instructional unit exceeded the combined total developmental production costs for one segment each of audio and video presentation.

C. Instructional Effectiveness.

A cost effectiveness report which merely presents cost differentials will be of no value to instructional planners and designers, since those instructional media or presentation forms which seem extremely expensive to develop might actually result in the highest rate and efficiency of learning for all students. Until the matter of instructional effectiveness is brought into consideration, instructional planners hold an unbalanced equation to guide their decisions regarding course design and form. Some may consider cost

the most critical factor and opt, therefore, for slightly less effective student performance. Others may well consider effective student learning and end-of-course performance to be most critical, at whatever the cost. In any event, intelligent planning demands consideration of both development cost and instructional effectiveness.

It is not the intent of this report to present conclusive evidence of the merits of one medium and/or presentation form over another. Rather, it is intended to show the relative efficiency of the various forms.

It must be made clear, however, that the statistics shown are not final, end-of-project figures, but are limited to results compiled after two complete course presentations at the U. S. Naval Academy. The first implementation of the total multimedia Leadership course occurred during the Spring semester, 1970; the second implementation during the Fall 1970 semester. The third implementation for the Spring 1971 semester continues at this writing; therefore, this data is not available.

Table 9 reports student performance for each instructional segment of the course, without regard for media or presentation form. The mean of 78% for all segments relates quite well with the stated goal of 80/80; i.e., at least 80% of the students will respond correctly to at least 80% of the criterion

measurement items. True, not all segments performed as well as desired, however, for a first validation field test, the results were not disturbing. Instructional materials were revised on the basis of careful analysis of empirical data prior to the second implementation of the course. The mean for all segments: 86%, is quite satisfactory. More important and noteworthy is the dramatic decrease (from 31 to 8) in the number of individual segments which did not meet the 80/80 standard.

One may still question the eight segments which did not perform as expected, but consideration must be given to the fact that, for the second implementation, a number of instructional segments were presented in new forms as a result of the deletion of the Learning Activity Summaries and the Videotapes. Thus, the situation there was one of a first field test, rather than a second validation run.

Naturally, the revision process, based on empirical data continued between the second and third implementations. Though complete data for the third implementation (Spring 1971) is not yet available, there are firm indications that the 80/80 standard will be attained in all cases.

TABLE 9

Progress Checks - First and Second Implementations
Mean Percentage Correct, Before Remediation

Segment Number	First Run	Second Run	Segment Number	First Run	Second Run
1.1	82	87	6.1	80	90
1.2	67	84	6.2	82	85
2.1	78	88	6.3	91	88
2.2	68	86	6.4	87	87
2.3	65	70	7.1	69	81
2.4	71	78	7.2	83	87
2.5	65	90	7.3	77	80
2.6	71	82	7.4	78	78
2.7	63	72	7.5	74	83
2.8	89	86	8.1	82	87
2.9	65	90	8.2	81	91
3.1	66	73	8.3	92	92
3.2	66	80	8.4	76	94
3.3	75	70	8.5	77	87
3.4	79	87	8.6	77	87
3.5	84	93	9.1	80	91
4.1	83	92	9.2	88	91
4.2	85	95	10.1	93	95
4.3	87	84	10.2	89	91
4.4	92	95	11.1	80	82
4.5	82	95	11.2	91	93
4.6	73	90	11.3	83	90
4.7	77	90	12.1	87	93
5.1	78	89	12.2	86	82
5.2	70	76	12.3	94	93
5.3	74	92	12.4	85	83
5.4	69	84			
5.5	59	82	MEAN - ALL SEGMENTS	78	86
5.6	70	82			
5.7	80	83			
5.8	90	90			
5.9	78	79			
5.10	66	90			

It should be noted that the needs of the students were not overlooked at any point in the course. This data is indicative of only the first iteration of each instructional unit. Any student unable to attain a score of 80% on the Progress Check for any instructional segment was immediately routed to remediation materials for that segment and retested. Students still unable to attain a score of 80% were then routed to individual tutorial sessions to assure mastery of the information presented. No student moved ahead until all concerned were confident that he had achieved mastery of the required learning.

The effectiveness data shown in Tables 10 through 16 inclusive, display the average percentage of Progress Check (criterion test) items answered correctly by the given numbers of students for each segment using a specific media or presentation form. Data is shown, for comparative purposes, for both first and second implementations (Spring and Fall, 1970), where applicable. The data reflect not only performance with the primary instructional unit (the basis for cost reporting) for a given segment, but also the performance with variant instructional units covering identical subject content, which were prepared to satisfy research demands.

TABLE 10

AVERAGE % PROGRESS CHECK ITEMS CORRECT, BY SEGMENT WITHIN MEDIA

VIDEOTAPE WITH PANELBOOK (VT/PB)

First Implementation

Part & Segment Number	Number of Stuients	Average % PC items correct
2.2	23	65.0
2.3	23	68
2.4	23	70
2.5	23	62
3.1	23	67
3.2	23	62
3.3	23	74
3.4	22	78
5.7	22	72
5.8	22	90
5.9	21	78
5.10	22	63
7.1	22	71
7.2	22	89
7.3	22	71
7.4	22	76
7.5	44	74
9.1	44	80
9.2	44	88

Second Implementation

(NOT USED BEYOND FIRST IMPLEMENTATION)

Unweighted mean % for all segments = 73.5

TABLE 11

AVERAGE % PROGRESS CHECK ITEMS CORRECT, BY SEGMENT WITHIN MEDIA

AUDIOTAPE WITH PANELBOOK (AT/PB)

	First Implementation		Second Implementation	
Part & Segment Number	Number of Students	Average % PC items correct	Number of Students	Average % PC items correct
2.2	21	73	42	86
2.3	19	64	42	70
2.4	20	73	42	78
2.5	21	69	42	90
3.1	21	66	42	73
3.2	21	72	42	80
3.3	21	76	42	70
3.4	21	81	42	87
5.7	22	83	44	83
5.8	22	89	44	90
5.9	22	77	44	79
5.10	22	67	44	90
7.1	23	68	43	81
7.2	23	80	43	87
7.3	23	81	43	80
7.4	23	79	43	78
Unweighted mean % for all segments		74.8		81.0

TABLE 12

AVERAGE % PROGRESS CHECK ITEMS CORRECT, BY SEGMENT WITHIN MEDIA

AUDIOTAPE WITH INTRINSIC PROGRAM (AT/IP)

	First Implementation		Second Implementation	
Part & Segment Number	Number of Students	Average % PC items correct	Number of Students	Average % PC items correct
4.4	44	92	44	95
4.5	44	82	44	95
4.6	44	73	44	90
4.7	44	77	44	90
10.1	44	93	43	95
10.2	44	89	43	91
Unweighted mean % for all segments		84.3		92.6

TABLE 13

AVERAGE % PROGRESS CHECK ITEMS CORRECT, BY SEGMENT WITHIN MEDIA

SYNDACTIC TEXT (ST)

	First Implementation		Second Implementation	
Part & Segment Number	Number of Students	Average % PC items correct	Number of Students	Average % PC items correct
2.6	44	71	41	82
2.7	44	63	42	72
2.8	44	89	42	86
6.1	44	80	44	90
6.2	44	82	44	85
6.3	44	91	44	88
11.1	44	80	43	82
11.2	44	91	43	93
11.3	44	83	43	90
Unweighted mean % for all segments		81.0		85.0

TABLE 14

AVERAGE % PROGRESS CHECK ITEMS CORRECT, BY SEGMENT WITHIN MEDIA

LINEAR TEXT (LP)

	First Implementation		Second Implementation	
Part & Segment Number	Number of Students	Average % PC items correct	Number of Students	Average % PC items correct
4.1	44	83	42	92
4.2	44	85	42	95
4.3	44	87	42	84
5.4	44	69	44	84
5.5	44	59	44	82
5.6	44	70	44	82
8.1	44	82	43	87
8.2	42	81	43	91
8.3	44	93	43	92
Unweighted mean % for all segments		78.7		87.6

TABLE 15

AVERAGE % PROGRESS CHECK ITEMS CORRECT, BY SEGMENT WITHIN MEDIA

LEARNING ACTIVITY SUMMARY (LAS)

First Implementation			Second Implementation
Part & Segment Number	Number of Students	Average % PC items correct	
2.9	44	65	(NOT
8.4	44	76	BEYOND
8.5	43	77	FIRST
8.6	44	77	IMPLEMENTATION)

Unweighted mean % for all segments = 73.8

TABLE 16

AVERAGE % PROGRESS CHECK ITEMS CORRECT, BY SEGMENT WITHIN MEDIA

COMPUTER ASSISTED INSTRUCTION (CAI)

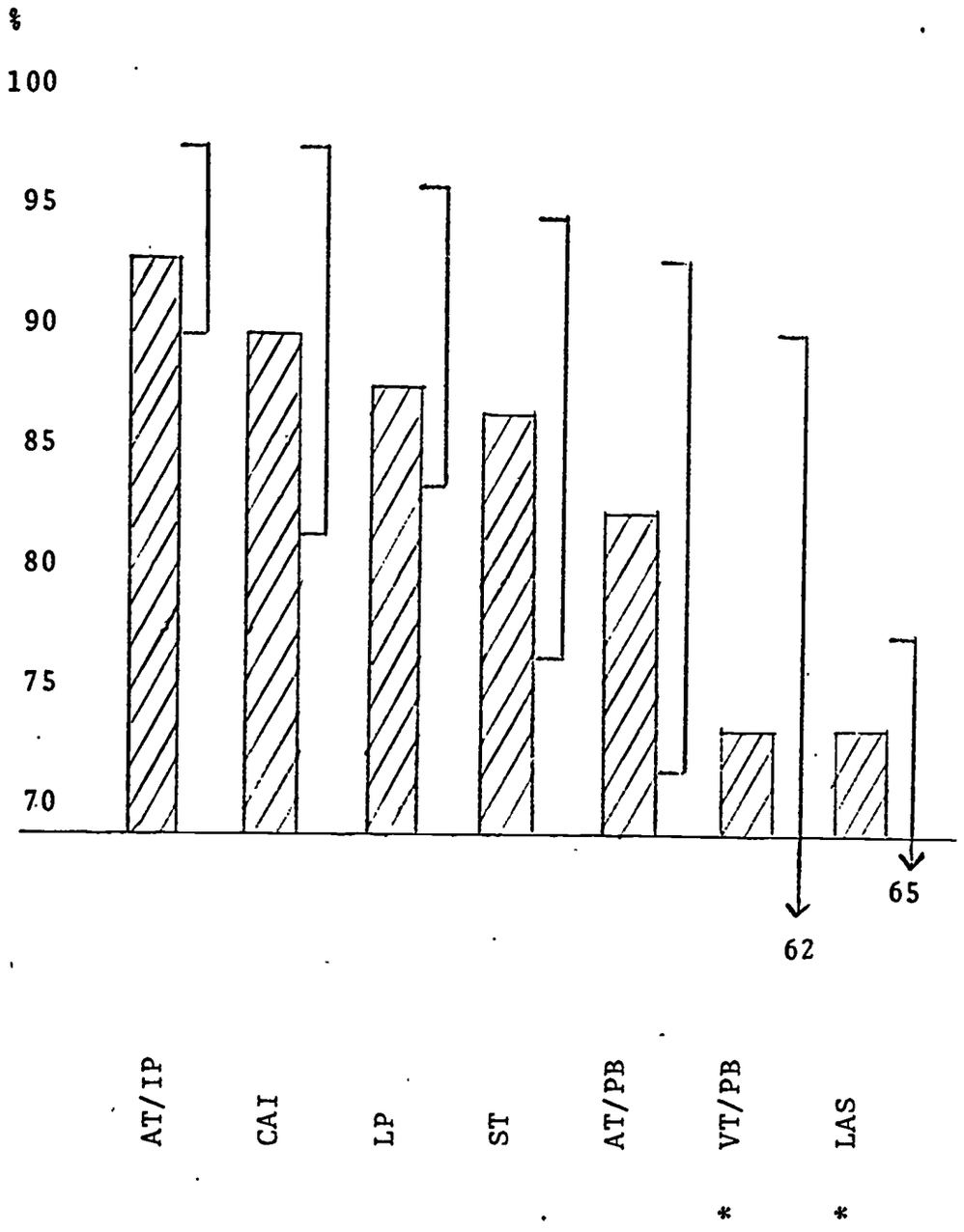
First Implementation			Second Implementation	
Part & Segment Number	Number of Students	Average % PC items correct	Number of Students	Average % PC items correct
12.1	44	87	43	93
12.2	44	86	43	82
12.3	43	94	43	93
12.4	44	85	43	83
Unweighted mean % for all segments		88.0		88.0

Figure E graphically portrays the learning effectiveness of the various media/presentation forms. There is a very important difference between this data and that reported earlier. Performance with variant instructional units covering identical content for research purposes, has been eliminated. Thus, the data in the figure has been refined to reflect performance only on the primary instructional units, and, therefore, correlates directly with the cost data reported previously.

FIGURE E.

RANGE AND MEAN % PC ITEMS CORRECT FOR
ALL SEGMENTS IN GIVEN MEDIA/PRESENTATION FORM

(SECOND IMPLEMENTATION - FALL 1970)



* Data for first implementation is presented for comparison only.

Table 17 reports performance for individual instructional segments grouped by media/presentation form. Again, data is restricted to the primary instructional units only and excludes the instructional variants directed by research design. This data also correlates directly with previously reported cost data.

TABLE 17

AVERAGE % PROGRESS CHECK ITEMS CORRECT, BY SEGMENT WITHIN MEDIA

(PRIMARY UNITS ONLY - SECOND IMPLEMENTATION)

AT/PB		AT/IP		LP	
2.2	93	4.4	96	4.1	91
2.3	73	4.5	97	4.2	94
2.4	78	4.6	90	4.3	84
2.5	88	4.7	92	5.4	84
3.1	75	Mean	94	5.5	89
3.2	77			5.6	84
3.3	72	ST		8.1	83
3.4	85	2.6	78	8.2	91
5.7	85	2.7	76	8.3	96
5.8	93	2.8	86	Mean	88
5.9	82	6.1	93		
5.10	91	6.2	89	CAI	
7.1	79	6.3	88	12.1	93
7.2	92	11.1	85	12.2	81
7.3	85	11.2	95	12.3	97
7.4	81	11.3	95	12.4	87
Mean	83	Mean	87	Mean	90

D. Discussion of Cost versus Effectiveness.

The data compiled for this report indicate that all but one of the media/presentation forms prepared for this project can be made effective to the 80%/80% standard, and no doubt to a higher standard, given sufficient time, effort and funds. Whether or not a given instructional form warrants the expenditure of resources required to reach the standard is another matter. It is not a matter that will be conclusively and categorically decided in this report.

Useful analysis of cost effectiveness begins with a comparison of overall performance of each media/presentation with the respective development costs, as in Table 18. Since the development costs are limited to those costs necessary to bring instruction to the student for the first trial, overall performance for a given instructional form is also limited to the results of the first course implementation at the U. S. Naval Academy.

TABLE 18

DEVELOPMENT COST PER MEDIA/PRESENTATION FORM
RANKED BY OVERALL PERFORMANCE

Media	Overall Performance	Development Cost
CAI	88.0%	$3782.
AT/IP	84.3	1815.
ST	81.0	1425.
LP	78.7	1207.
AT/PB	74.8	1527.
VT/PB	74.0	1962.
LAS	74.0	822.

It should be noted that there is no significance attached to the fact that the instructional form that ranked highest in performance also was the most expensive to develop. There was no unusual effort devoted or emphasis given to the preparation of the computer assisted instruction. The occurence is seen as no more than mere coincidence.

Attention is drawn to the case of the Learning Activity Summary as the least expensive form to develop and the least effective in performance. As data was compiled and examined, following the first implementation, it was decided to delete all LAS units, even though that form was the least expensive to prepare. It was impossible to visualize the means to improve performance.

The LAS units are, by design, quite simple and straightforward in presentation form. It was judged that, as guidance for student study increases and the information presented becomes more refined and specific, the actual form of the materials moves farther from the Learning Activity Summary design and approaches a true programed text. In the situation at hand, it would have been fruitless to expend additional resources to improve performance with a presentation form that permits so few opportunities for revision without losing the designed form. Far better to discard the LAS form and prepare the content in a more auspicious media/presentation, as was done.

Deletion of the videotape presentations also came about as a result of the analysis of data compiled after the first implementation of the course concerning costs, student attitudes and student performance with the media form.

In the preliminary analysis of variance for the pertinent research hypothesis, significant differences in performance were found between videotape and audiotape instructional units. It could be argued that the videotaped instruction could have been effective, had the medium been used to its full potential (i.e., if the videotape had been largely pictorial rather than being specifically restricted to filmed lectures). It is

important, however, to point out that videotapes and audiotapes were identical in content and presentation variables for research; therefore, it is assured that no student is deprived of the opportunity to succeed in the course.

This finding tends to support the WLC hypothesis that it is not the media, per se, but the form of presentation in the media which is critical to effective instruction.

Another consideration for deletion of videotapes was the projected cost and the practicality of having so expensive a medium carry sixteen segments of instructional material when that same content can be presented as effectively in a less expensive mode. When large numbers of students are enrolled in the Leadership course, there would doubtless be congestion at the videotape consoles.

Another reason was simple cost. Videotapes, as they were developed, showed indications of being inferior to the audiotapes and were considerably more expensive to develop. This coupled with careful estimation of the necessary revision costs (estimated at $606. or fully 33% of the original development cost) brought the conclusion that the cost of revising videotapes for the second implementation was not justifiable. Since WLC was directed to plan and produce the most effective

instructional system possible to leave with the Naval Academy at the end of the project, it was deemed to be a waste of time and funds to develop a second set of videotapes restricted to simple taped lectures. Furthermore, future revisions of the tapes by the Naval Academy in years to come would also be cost prohibitive and their continued use is a matter for some speculation at this point.

A reasonable analysis of cost versus effectiveness must also take into consideration the costs and the results of the revision activities necessary to achieve validated instruction which brings about the desired level of student performance. Table 19 compares the average percent of increase in performance realized after revision of the materials with the costs of the revision. Costs are shown as a percentage of the original developmental cost, with actual dollar values in parentheses.

TABLE 19

MEDIA/PRESENTATION FORMS - RANK ORDER BY PERFORMANCE INCREASE

	Increase	Cost	
LP	8.9%	12.5%	($156.)
AT/IP	8.3%	20.0%	($344.)
AT/PB	6.2%	14.3%	($206.)
ST	4.0%	8.3%	($122.)
CAI	----	----	Not Revised.

Direct correlations between the increase in performance and the cost of revision is not advisable, due to the many factors which determine the requirements for revision and the varieties of activities which may be considered as revision activities. Good examples are the computer assisted instruction units which incurred continual small costs over a period of time as the "debugging" process was carried out, yet little activity occurred that could be isolated and identified as pure revision on the basis of empirical evidence. Generally speaking, however, the trend is that revision costs increase as the instructional materials are bound to more sophisticated hardware.

A valid conclusion would be that, where course design and specific course content are in a state of flux, i. e., not firmly established and agreed upon by all concerned at the outset, instruction dependent upon hardware for presentation should be held to a minimum.

VI. OTHER CONSIDERATIONS

A. Cost Variables Not Considered.

A research and development project of the magnitude undertaken at the U. S. Naval Academy incurs a vast array of costs not detailed or treated in this report. A great number of these costs, while an absolute necessity for the success of the project, are not pertinent to this report, since they arise from activities not critical to the purely developmental functions for the instructional materials.

Data processing activities over the three year life of the project incurred expenses of over $100,000.00 for operational programs and actual machine time. Initial system analysis and design costs are not included in that figure. Although we can roughly estimate that 40% of that cost supported strictly research activities and the remainder provided the empirical basis for materials revision, we have no feel for the accuracy of the estimates. A number of machine outputs served both research and development processes and cannot be accurately charged against one or the other. For the future, there is real doubt concerning the necessity for sophisticated data collection and processing to verify

the continued efficiency or signal the need for revision in an established, on-going course of instruction.

Management costs, too, defy precise categorization. All management personnel are professionals attuned to the managerial needs of the project and functioning primarily in that capacity. As a need arose, however, all managers lent a hand, as necessary, in some other skill which is in his repertoire. Thus, the project Business Manager, with broad personal experience at Naval Leadership, more than once performed as a Subject Matter Expert reviewing the instructional materials. Other management personnel assisted with writing tasks, continuity reviews and so forth, when needed. As one found a bit of time free from active management functions, another task was taken on for whatever time could be allotted to it. Isolating and detailing such cost is a practical impossibility.

A variety of personnel on the staff at the U. S. Naval Academy, too, devoted many hours of assistance to a large number of project activities, as an adjunct to their professional and professorial duties. No way has been found to identify and categorize the amounts of time so spent, and then isolate and identify the cost according to specific media/presentation form or to a specific instructional segment.

The reasons for not treating costs of the type briefly touched on above should be obvious. It is a certainty that no future large-scale research and development project will ever replicate the exact conditions surrounding this effort. It is desired to provide, to others responsible for instructional planning and design, data of validity and relevancy to their efforts. This goal, alone, established the limitations for kinds of costs included in this report.

B. Suggested Future Research.

Past cost-effective studies have considered performance in relation to actual and amortized costs per media, cost per student hour, per specific numbers of students per hour and per given numbers of students over many hours. Not surprising is the fact that none of the reports known to the staff has treated cost effectiveness in a longitudinal study to measure effficiency over a protracted time span. It is suggested that this is an area for fruitful future research. Envisioned is a study of cost effectiveness in relation to media efficiency and student performance as functions of initial

learning, retention over time and practical performance in a post-instructional environment. Great value may result from such a study, particularly when the attitudes, skills and knowledges imparted are directly related to the task environment the student meets upon course completion.

Another valuable study would be the cost effectiveness of videotaped instruction in the form of taped lectures versus a pictorial form which utilizes the full potential of the medium. The indeterminate results attained in this project with taped lectures has not dampened the enthusiasm for the medium. Instead, it points rather clearly to the need for further research into the potential of various presentation forms within the medium.

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